

## PSYCHOLOGICAL AND PHYSIOLOGICAL STRESS

The Psychological and Physiological Effects of Stress on Firefighters

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## CERTIFICATION STATEMENT

I hereby certify that this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate and that appropriate credit is given where I have used the language, ideas, expressions, or writings of another.

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## ABSTRACT

The problem is that the Atlanta Fire Rescue Department (AFRD) has been unable to link the effects of the various types of stress on firefighters, following two of the department's recent Line of Duty Deaths (LODD). The purpose of this applied research paper was to determine how stress affects firefighters and to use the findings to influence the reduction of the occurrence of serious injuries and death to fire personnel. Research questions sought to find the various types of stress that firefighters endure as well as how the stress affects the properties of the body and the mind. The other research questions asked how firefighters manage their stress and prepare their bodies and mind to perform efficiently under stress. A descriptive research method was used which included a survey and a vital signs study of active firefighters within AFRD. The research yielded that there is a marked increase in physiological response to perceived stress as well as physical exertion of firefighters.

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## Introduction

The problem is that the Atlanta Fire Rescue Department (AFRD) has been unable to link the effects of the various types of stress on firefighters, following two of the department's recent Line of Duty Deaths (LODD). Therefore, this lack of knowledge and understanding leaves the remaining 1,200 firefighters vulnerable to the same fate. This Applied Research Project (ARP) will serve the purpose of determining the effects of stress on firefighters in an effort to spread valuable information to the members of the AFRD. The overshadowing and long-term goal of the paper is to influence widespread awareness and interest to the fire service in general, thus reducing the number of serious firefighter injuries as well as a reduction in the number of LODD that could be related to stress. The following research questions were created to obtain an assortment of information that is crucial to the research of the effects of stress on firefighters: What are the various types of stress that firefighters commonly endure? How do the various types of stress affect the physical properties of the body? How does stress affect the psychological processes of the mind? How can firefighters prepare their bodies to perform efficiently under stress? What can firefighters do to prepare for psychological stress during traumatic events?

This applied research project will use the descriptive research method to learn the effects of stress on firefighters. In addition, this project will consist of the following:

1. An extensive literature review that will bring light to what other individuals, who have authored documents related to the effects of stress, feel about this substantial issue.

2. Data compiled from research participants, surveys and studies will attempt to demonstrate how firefighters are affected by psychological and physiological stress.

### Background and Significance

It has been said that the occupation of a firefighter is one of most stressful and dangerous occupations in the world. National campaigns have been highly publicized, in the firefighting community, as department leaders emphatically push to prevent and reduce serious injuries and firefighter fatalities. The United States Fire Administration(USFA) has it eyes on this subject as displayed by one of the USFA's operational objectives that focus on reducing firefighter fatalities. The Atlanta Fire Rescue Department (AFRD) experienced two separate line of duty deaths in 2006. Just as in most fire departments across the country, AFRD has concentrated a great deal of energy towards firefighter safety and survival training. Being fully aware that all firefighter injuries or fatalities are not the result of the perceived traditional traumatic circumstances, such as thermal and crushing injuries, AFRD has continued an aggressive campaign on the health and wellness of its firefighters. Programs and initiatives that focus on education, better practices and physical wellness are at an all time high. Unfortunately, stress has never been considered a serious issue of influence of our firefighters' death. Nor has any need for future prevention of similar LODDs that may happen within AFRD and can be attributed to stress. It is with great hope and anticipation that this applied research project will highlight and bring together valuable information that focuses on the psychological and physiological effects of stress. In addition, the author seeks to combine the knowledge gained from the Executive Fire Officer Program's Executive Development course to enrich thoughts and actions aimed at reducing the loss of firefighters in the line of duty throughout the fire service.

## Literature Review

This literature review was structured for the benefit of the author and influence of the direction of the project's five research questions. I found it necessary to gain clarity on what the term stress implies. Hawker (2002) defined stress as mental or emotional strain. Although this definition is a straight and to the point dictionary definition, further review conducted within this research project revealed several more complex concepts of stress. McEvoy (2002) wrote that stress is not an event but rather our reaction to an event. He also believes that stress is a person's reaction to people and objects and the happenings they bring into one's life. Neddermeyer (2007) wrote that stress is a perception. She went on to mention that a perceived stressor by one individual might not be perceived as a stressor by another. Therefore, stressors affect people differently and at various levels. Cline (1999) defined stress as bodily or mental tension resulting from factors that tend to alter an existing equilibrium.

The first issue of interest deals with identifying the types of stress that can be related to the occupation of firefighting. The literature review revealed a moderate amount of information that can be associated with the stress that firefighters endure. In a broad or generalized sense, stress will typically fall into two categories. The first is psychological stress and the second is physiological stress. Brigati (1995) wrote that stress not only causes changes in physical health, but cognitive and behavioral changes result in ways we may not have previously associated. Wieder (1999) believes that behavior on the fire-ground can influence deadly effects of environmental stress and says that proper firefighter rehab should focus on the firefighter's physical condition by way of rehydration, nourishment, rest, medical evaluation as well as the firefighter's mental condition. Wieder believes that a firefighter's physical and mental status can deteriorate to a point where that individual adversely affects the safety or integrity of the

operation. Cline and Chapel (1999) wrote that there are four categories of psychological stress: acute, cumulative, delayed and post-traumatic stress disorder (PTSD). Becknell and Ostrow (2002) wrote that some experts contend that the exposure to disasters in emergency services makes responders likely to experience psychological fallout. They highlighted the concept of post-traumatic stress and describe it as anxiety that can occur following experiencing or witnessing life-threatening events, such as military combat, natural disasters, terrorist incidents, serious accidents, or violent personal assaults, such as rape.

While reviewing how others believe the various types of stress affect the physiological processes of the body, the author found an array of opinions. Barnes (1999-2000) said that physical exhaustion is likely to be the most benign ‘take-home’ artifact of the sub-culture of firefighting. Smith (2001) made the analogy of a fire engine to one’s cardiovascular system. She says that when heavy demands are encountered like muscular work, heat stress, or a combination of both, vital organs require more blood. She goes on further to mention that at the highest time of demand, the heart’s pumping capacity is impaired to work at an optimum level. Smith advises that as heat strain increases, stroke volume decreases. During her research, she found that after only 17 minutes there was a substantial reduction in stroke volume in healthy young men. Smith contends that the heat stress and dehydration that accompanies firefighting duties leads to cardiovascular strain because of the compromised pumping capacity of the heart. Peters, et al. (2007) concluded that lead exposure and psychological stress, when combined together, exacerbates hypertension. Brigati (1995) said that stress causes a physical response in the body as we adapt to changing conditions. He suggests that changes such as elevated blood pressure, increased oxygen consumption, greater skeleton muscle tension, glucose level alteration, vassal constriction of abdominal and skin arteries as well as bronchial dilation prepare firefighters for



immediate action. In an online article by Personal MD (2007), the author mentions that a study of heart patients who demonstrate high levels of mental stress in daily life more than doubles the risk of myocardial ischemia. The article also states that common emotions such as tension, frustration and sadness can trigger a drop in blood supply to the heart. The author also mentions a study that was conducted by Duke researchers that explain the results of a study completed in an experimental setting. The study showed that stress caused by performing challenging mental tasks can cause an increased risk for future cardiac events. Raeburn (2006) says that studies have tied stress to immune suppression, including a surplus of flu and colds. He also, interestingly, implies that an enormous amount of success is healthy only for people with self-esteem to match. He mentions an example of the stress of a person with low self-esteem hitting a homerun out of the park may tax the immune system and thus help send the body spiraling into disease. Adam & Epel (2007) say that repeated stimulation of the reward pathways, through stress induced hypothalamic-pituitary-adrenal, may lead to neurobiological adaptation that influences the development of a compulsive nature of overeating. An article in Natural Life Magazine (2007) links stress to weight gain. The researchers used lab mice and provided them with standard feed that would be equivalent to human junk food and subjected some of them to chronic stress. The study found that only the mice that were subjected to chronic stress gained significant weight. The article also noted that there was an increase in fat-deposit, around the stomach area, of the stressed mice as well. Malley (1995) says that one inevitable consequence of the high-risk, high-intensity exercise, otherwise known as firefighting, is heat stress. Malley states that heat stress influences the health, safety and performance of every working firefighter at all operations. Innes, Vincent and Taylor (2007) offer evidence that chronic stress plays an important role in the development and progression of insulin resistance syndrome and ultimately cardiovascular disease. Pardon (2007) says that stress can either diminish or exacerbate the ageing process.

Torpy (2007) suggests that the effects of stress on the heart ranges from increased pulse rate to spasms of blood vessels in the heart, thus causing sudden heart attacks, arrhythmias and even death.

Another concern deals directly with how stress affects the psychological processes of the mind. Peavy, et al. (2007) conducted a study and determined that low-stressed subjects performed better than the high-stressed subjects on delayed recall of stories, word lists and visual designs. Thus indicating that memory is adversely affected in higher stressed individuals. Luine, Beck, Bowman, Frankfurt and MacLusky discuss Selye's findings whereas short-term stressors elicit adaptive responses and long-term or chronic stressors result in maladaptive changes. Thus having a harmful effect on the subject's physiological systems as well as impairing their cognition. The group of authors found that females display different cognitive responses to stress. The researchers discovered that the male rodents displayed impaired cognition following their chronic stress. The female rodents displayed enhanced performance with memory tasks following the administration of the same chronic stress. Barnes (1999-2000) reported that emergency workers who are repeatedly exposed to traumatic stressors may be more likely to suffer from progressive emotional dysfunction. Reichel (1996) wrote that vertical and horizontal relationships contribute to firefighter burnout. Fishkin (1991) says that every organization has conditions or elements that contribute to or trigger employee stress. His article emphasizes the need for a heightened awareness for organizational stressors. Fishkin believes that firefighters and administrators can be affected by these stressors. He also mentions that even the new firefighter experiences organizational stress. An example that was used explains that a new firefighter may know that something is wrong, but is compelled by tradition to mold his style to that of his superiors. Mozingo and Plotkin (1997) wrote that research indicates that the

repetition of moderately-rated stress events contribute more to psychological trauma than a single high-rated stress event. Their article, *The Middle Ground*, focuses on three types of stress: ordinary stress, the middle ground and critical incident stress. The authors explain that ordinary stress is indicative of the difficulties and adjustments that are confronted on a daily basis. Examples were listed as financial issues, interpersonal conflicts at work, marital problems and difficulties with kids. According to the authors, ordinary stress receives the most research, education and public attention. They discussed critical incident stress as usually being the result of an individual encountering a major traumatic experience. These incidents are typically dealt with by facilitators conducting a debriefing session for the responders involved. The authors describe the middle ground as being an area of limited research and is widely neglected. They mention that traumatic stress builds up in an individual's emotional bank and should be taken seriously.

The fourth question that this research project set out to answer, involves how firefighters can prepare their bodies to perform under stress. Reviews of literature found that Smith (2001) believes that there are a couple of recommendations that could lessen the cardiovascular strain of the heart and thus reduce the risk of a heart attack. Firstly, Smith believes that firefighters should be physically fit. She suggests that aerobic exercise increases the strength and efficiency of the heart muscle. Smith offers the notion that a physically fit person's stroke volume may exceed the stroke volume of an untrained person as much 50%. Smith adds that a 20-25% increase in plasma can be the result of physical training as well as greatly reducing the risk of having a heart attack. Secondly, Smith recommends that proper staffing is essential to ensure that work crews are provided with adequate rehabilitation. Finally, Smith recommends that firefighters aggressively hydrate and rehydrate. She believes that, in addition to arriving at work fully

hydrated, firefighters should be careful to stay hydrated throughout the day. This includes in the station, on the scene and even after firefighting activities. Parker (2001) wrote that warm, humid environments dramatically decrease the effectiveness of the body's ability to lose heat by way of evaporation. Parker also asserts that heat stress in these dangerous environments make individuals vulnerable to a critical state of dehydration and an increase in core temperature.

The final research question focuses on suggestions of things that firefighters can do to prepare themselves for psychological stress. Neddermeyer (2007) suggests that people should make a list of all the things that prompt them to have a perception of stress. She also advises to prioritize each item on the list as to how strong the perception of stress is. Neddermeyer goes on further to mention that by making long-term plans to alleviate stress, one is able to reach optimal ability to channel stressors properly. She believes that by knowing that one can change his or her perception or circumstances will allow one a sense of empowerment, which increases one's responsibility for perception. Seaward (2000) mentions several coping and relaxation skills that can assist firefighters with managing their stress. He believes that affirmations, journaling and humor are great mental strategies for changing a threatening perception to a neutral or positive one. He explains that affirmations replace negative feedback with positive ones that can nurture a sense of high self esteem. He also described journaling as a tried and true method in which the responder would jot down and reduce their thoughts or feelings onto a piece of paper. Finally, he suggests that black humor or gallows humor is the only way to cope with repeated exposure to horror. Seaward offers the suggestion of diaphragmatic breathing, safe physical exercise, healthy nutrition, massage/whirlpool and mental imagery or meditation as ways to relax from stress. Rivard (2007) implies that stress starts in the mind and that it is the ability of the person to know where and when to relax. In an article named, *How to Relax After Work* (2007), the author

discussed the concept on unwinding and designating a period of time between 30 minutes to 1 hour to release the need to respond to others electronically. The article suggests the stressed individual take a moment to savor his or her serenity and peace of mind. Rhéaume (2007) promotes psychological health through botanicals called adaptogens that can strengthen the body's ability to cope with stress as well as increasing the resistance to emotional trauma, anxiety and fatigue. The author lists and describes Siberian ginseng, Indian ginseng, Rhodiola and Lavender as beneficial adaptogens. Fishkin (1991) offers several suggestions for firefighter to reduce stress through a method that he refers to as the helping process. He discusses at great length the areas that fall within the self-directed approaches for resolving firefighter stress. Under this approach, he includes awareness of the problem or stressor, stress monitoring – to track the “internal thermostat”, communication of one's emotional pain, objectively evaluate one's attitude towards the stressor, lowering self-expectations so that they are in line with reality, examine the personal myths which one operates under – psychological baggage and integrating areas of gray into one's thinking. Fishkin also recommends that firefighters use resources from the community, individual counseling, psychotherapy or by usage of resources that may be available in the workplace such the various types of leave or by using medical referral.

In summary, the results of the literature review provided a large amount of information on the both the physiological and psychological effects of stress as well as the recommendations that others contend would be beneficial to firefighters in coping with and reducing stress. Unfortunately, there is a considerable unbalance of available information that focuses on the psychological performance and decision making abilities of firefighters within a stressful environment. Initially, the research was geared towards how stress affects the body and mind. During the literature review, the author discovered that the experience and perception of physical

stress influences the psychological status of cognition. Conversely speaking, psychological stress plays a major role in the physiological responses that most are so familiar with. On several occasions, the author found it difficult to keep physiological stress and psychological stress completely separate because of their close correlation as evidenced by other researchers intermingling the two concepts as well.

### Procedures

The procedures employed to engage this research project involved several categorical steps. These steps included acquiring the medical equipment needed to conduct a study. The author determined a method for conducting a vital signs study. The author defined the group participants that will be involved in the vital sign study and the participants that will be involved with the survey. The author then created user-friendly survey questions. Additionally, the author developed a means of administering the survey. The combining of the raw data was also considered to best illustrate the results of the research. Finally, interviews were conducted by the author with health and mental professionals.

The first step in the procedures of this project began with the consideration of the numerous methods of collecting raw research data. The collection of this raw data was crucial to answering the second research question which involves the physical effects of stress on firefighters. It was determined that a vital signs study would serve as a valuable means of researching and documenting how a firefighter's body responds to various situational types of stress while on duty. The author was able to borrow a new portable pulse ox-meter that has the capability of measuring the percentage of oxygen in the blood and the pulse rate of an individual in a matter of seconds. The device operates by placing it on the finger tip of an unpainted fingernail. The advantage of this portable device was that it is a small, fast and moderately accurate

assessment tool. Participants were assessed while enroute to and from emergency calls as well as while they were conducting various activities in the fire station. Assessments were conducted while the firefighters were sitting at the table for the morning muster, while resting, while sleeping, while on the fire apparatus, while responding and on the fire ground. The author also borrowed a stethoscope with a blood pressure cuff set with the sizes of child, adult and large adult for bigger participants. Having the proper size cuff promotes accurate blood pressures.

In determining how stress affects firefighters physically, it was necessary to select and establish a method for conducting the vital signs study. The study would involve on-duty firefighters at moderately active to active fire stations. Blood pressures were taken near the beginning of the shift. The shift began at 0700 hours and the baseline vitals were taken at 0800. This procedure was set to allow firefighters time to calm down and rest a bit after the travel to work as well as dealing with the loud and rowdy conversations that take place at shift change. Initially, vital signs were to include blood pressure, pulse, respirations and blood-oxygen saturation. The author's intent was to use the information as an objective tool to demonstrate how a firefighter's body responds to various stimuli or stressors throughout a typical tour of duty. Due to various unpredictable responses and activities, the author found it impractical and extremely inconvenient to the participants and their duties to set time schedules for vitals. The author decided against including respirations in the study. This was primarily the result of the respiration assessments being time consuming with minimum variations in addition to the participants altering their respirations. Taking blood pressures became time consuming and the participants became increasingly uncooperative. The author decided to remove this statistic as well. Therefore, the raw data that was obtained from the vital sign study included pulse rate and oxygen saturation throughout the day for 5 shifts. The criteria that would warrant the random

assessment was: the firefighter must be relaxing or sleeping without verbal interaction with others for a minimum of 30 minutes or the firefighter was suddenly notified of the need to respond to an emergency.

Additionally, participants for the vital sign study were defined as 5 full-time, paid, on-duty firefighters at Atlanta Fire Station 7A. Participants were between the ages of 37 and 45. None of the participants were obese and all are considered to be healthy and very active. The participants' ranks included firefighters, fire apparatus operators, fire-medics and a captain. The participants for the survey consisted of all full-time, paid firefighters at Atlanta Fire Stations. Data collected from this survey group contributed to answering three of the research question. These three questions involved the types of stress that firefighter experience as well as how does physical and psychological stress affect firefighters. Numerous limitations were encountered when the author considered sending the survey to all of the members of AFRD. Therefore, the author selected stations that are moderately busy to very busy with their day-to-day operations. Stations 7, 9, 16, 25 and 31 were used to recruit 37 survey participants. The participants' ranks included firefighters, fire apparatus operators, fire-medics, lieutenants and captains. All participants freely volunteered and were not compensated in any way for their assistance with this research project.

The author determined that it was necessary to create the most appropriate and tactful survey questions to yield the best results. The participants will be firefighters. Understanding that firefighters are known to work in a proud culture where image is everything, the survey process and questions needed to be non-threatening as to promote honesty from the participants. The author's intent of the survey was to obtain data from firefighters who may or may not have experienced some of the effects of stress. The survey consisted of seven questions. The first



question addresses whether or not the participant has experienced any type of constricting feeling or pains in his or her chest. This type of discomfort could possibly be the result of extreme exertion, vascular blockage that could influence a myocardial infarction or respiratory issues. The second question focused on feelings of nauseous and dizziness. Both of these symptoms are typically experienced during heat exhaustion and severe physical fatigue. The third question on the survey addresses dehydration concerns. A classic symptom of dehydration is muscle cramps. The author chose not to ask participants whether they have experienced dehydration due to concerns of the probability of decreased candidacy from the participants. The fourth survey question highlighted concerns of stress influenced decisions. These untamed decisions are made by individuals during the heat of battle and typically go against all training as well as common sense knowledge. The fifth survey question deals with whether or not the firefighter has been aware that his or her body is adjusting in preparation for a perceived stressful event. Survey question number six attempts to tactfully ask the participants if they have been startled by the alarm notification system. The question references the participant being awakened from a deep sleep because of the surmised large difference in the heart rate. The seventh and final survey question attempts to assess whether the participant believes that he or she has a general awareness of how physiological and psychological stress affects the mind and body.

The next step in the procedures is related to how the survey would be administered to the participants. The answers would be simple YES / NO bubble-in. The author considered using a web-based survey in which answers would be submitted back to the author via the internet. Another option was to send an emailed version of the survey throughout the entire AFRD for any volunteers to be printed and complete the survey at the fire house. The completed survey would have been collected by the author at a later time. Both options were dismissed due to concerns of

valid participation without directly speaking to the potential participants as well as concerns of using fire department equipment and the limited supplies for this project. The author chose to take printed versions of the survey to the aforementioned fire stations in the city of Atlanta and ask for volunteers to participate. Upon completion, the surveys were immediately placed into a folder for safe keeping. The surveys did not require any identifying information. Therefore, the surveys were anonymous in nature. The author was available for questions or clarification if needed during the survey.

The raw data was then compiled and charted to display the results. Vertical bar charts were created to display the data. For the vital sign study, two general statistics are represented. The first is shaded with vertical stripes and represents the participants' vitals while resting or asleep. The second is shaded solid and represents the participants' vitals immediately or shortly after being notified of the need of an emergency response. Each chart shows the 5 un-named vital sign participants' average stat. There are a total of three charts that represent the vital sign study - blood-oxygen saturation, pulse rate while resting and pulse rate while asleep.

Finally, the author interviewed AFRD's medical director as well as a practicing psychologist in an effort to contribute to answers to four of five questions. Jim Augustine M.D. and Ann Moore PsyD. were interviewed separately and were asked different research questions. The medical director/ER doctor was asked specifically about how physical stress affects firefighters and how firefighters can prepare their bodies for physical stress. Dr. Moore was asked how stress psychologically affects firefighters and how can firefighters prepare themselves for psychological stress.

## Results

The first research question inquired about the various types of stress that firefighters commonly endure? There was a great deal of feedback, information and research available concerning the subject of the types of stress that is experienced by firefighters. Information gathered from firefighters during open discussion indicates that firefighters endure a great deal of stress in a wide variety of fashions on various levels. The terms physiological stress and psychological stress offers an answer to the first research question concerning the types of stress that firefighters endure. It was found that physiological stressors such as prolonged exertion, sleep deprivation, extreme temperatures, pain, and acute changes in the working environment are all a part of a firefighter's day at the office. Firefighters reported experiencing psychological or cognitive stress on and off the job. Several firefighters suggest that it is difficult to leave stress at home as well as it being equally difficult to leave stress at work. The challenges of being a first responder at work and a parent, spouse or friend at home can become overwhelming and manifest within the firefighter. The research suggests that the compilation of stress may accumulate and progress into what is known as post traumatic stress disorder and then magnifies any other preexisting stressors.

The second research question asks about how the various types of stress affect the physical properties of the body. During an interview, Dr. James Augustine (J. J. Augustine, personal communication, August 7, 2007) advised that firefighters working in extreme temperatures may experience adverse reactions or consequences of physical stressors. He also contended that the high degree of acute temperature variances wreak havoc on the body's temperature regulatory system. Dr. Augustine emphasizes that a large portion of the exacerbated effects of physical stress are the result of a firefighter's body preparing for the anticipated work

as well as actually conducting the hard labor. He mentions that physical and psychological stress can increase pulse rate, influence hypertension and increase the body's demand for blood and oxygen. Dr. Augustine contends that he has seen several situations in which firefighters had worked themselves past exhaustion and did not follow the guidelines and rules of basic firefighter rehab. He furthermore believes that through proper education and implementation of physical fitness programs, health screenings and rehab procedures, the severity and number of firefighters who are adversely affected by physical stress can be reduced. In addition to Dr. Augustine's interview, survey question number one (Appendix A) yielded that 38% of the participants indicated that they have experienced chest discomfort or an increase in difficulty breathing during or after firefighting activities. The remaining 62% denied having any type of discomfort from the stressful activities. Survey question number two inquires whether or not participants have felt nauseous or dizzy following firefighting activities. Of the participants surveyed, 44% indicated that they have experienced a nauseous or dizzy feeling during or after those strenuous events. The author took into consideration that the nauseous feeling could have been the result of the participant eating a full meal and then conducting hard work. However, this question was important because it shows the intensity exerted by the firefighters performing their duties. Question number three asks participants if they have had muscle cramps during or after firefighting activities. 51% of those surveyed indicated that they've had muscle cramps. Muscle cramps are typically related to exertion, electrolyte balance, hydration and body temperature issues. Survey question number six asks whether or not the participant has ever received an alarm that woke them from a deep sleep and the participant noticed palpitations as their heart rate dramatically increased. This question was very important because it demonstrated the concept of the heart racing from zero to a hundred. Participants who answered yes to this question accounted for 67% of the surveyed group. The author believed that some answers were skewed

because the participants did not answer as honestly in fear of not providing a rough, tuff, real-man answer. The blood-oxygen saturation level (Table 1) produced only mild variations throughout the entire study. Firefighters who participated in the vital sign study showed an average of 15% increase (Table 2) when responding from resting and a 58% increase (Table 3) in pulse rate from being asleep. Pulse rates were taken within 60 seconds of being awakened after the buzzer sounded.

Table 1

Percentage of blood-oxygen saturation variations

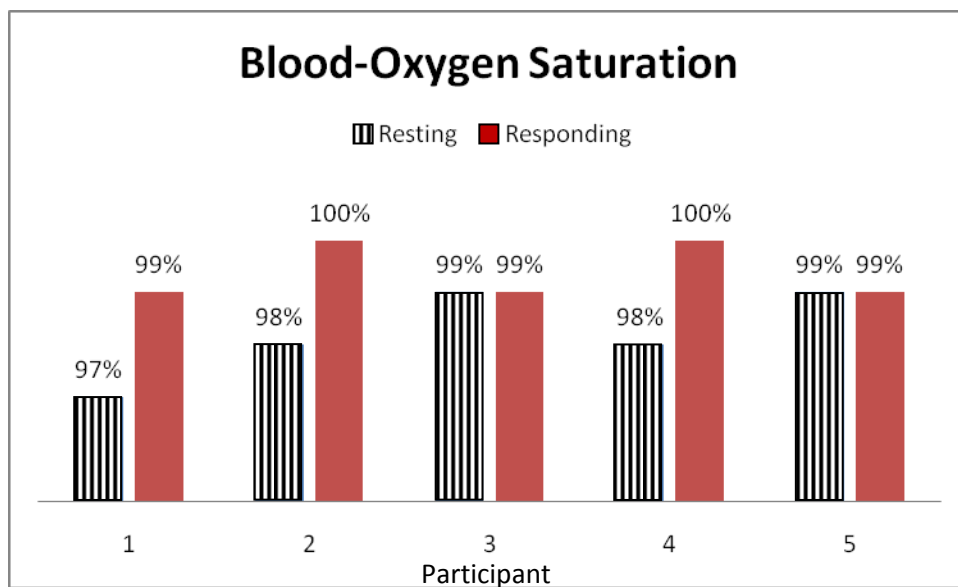
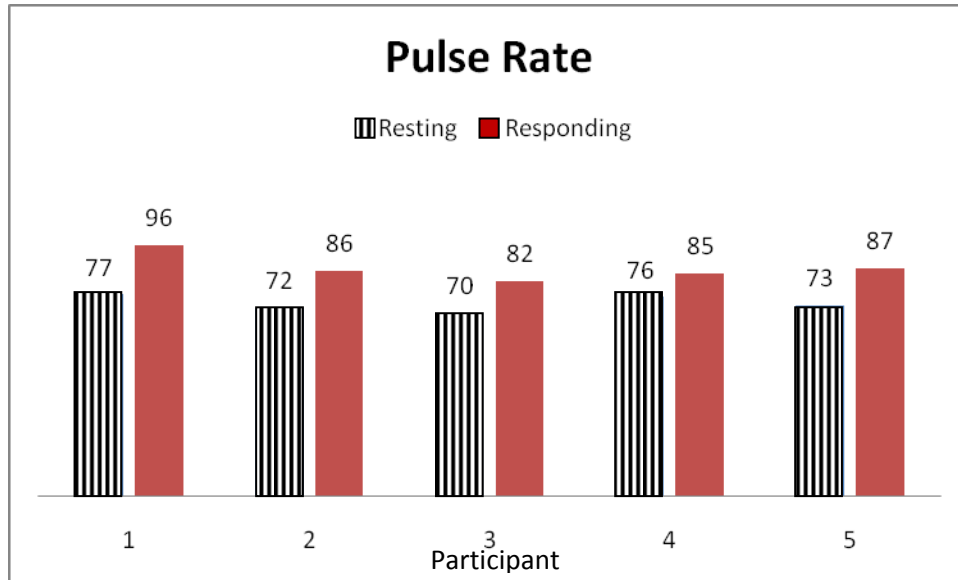
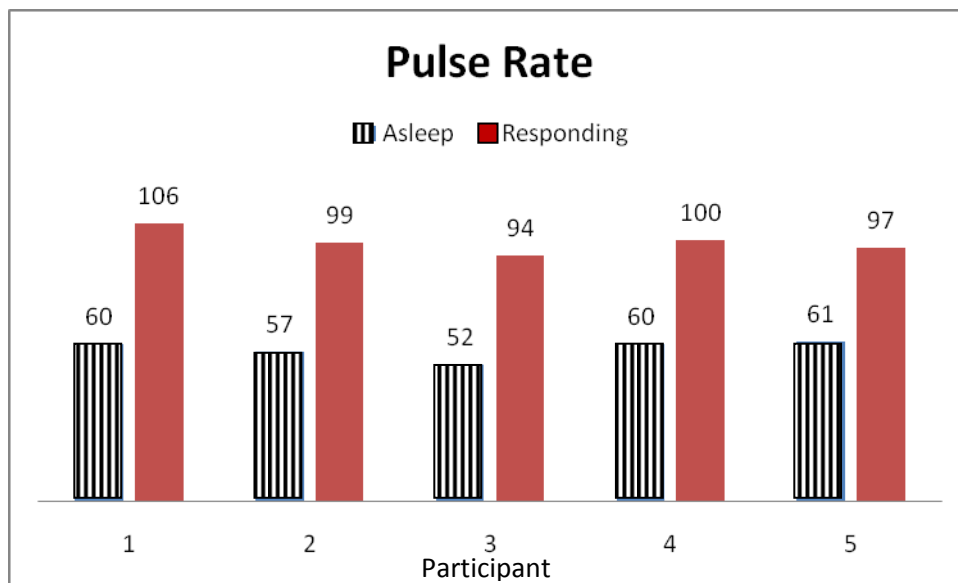


Table 2

Pulse rate variations from resting



Pulse rate variations from being asleep



The third research question asks how stress affects the psychological processes of the mine. During an interview with Ann Moore (A. Moore, November 10, 2007), she insisted that certain professions will inevitably be exposed to various levels of psychological stress. She believes that this stress is perceived and handled differently by everyone who experiences it. Dr. Moore goes on further to mention that emotions are an incredible factor in are psyche. She explains that normal thought processing patterns can be dramatically disrupted as well as one's physiological status such as vital signs and digestive systems which both can undergo an enormous change. In addition, she mentioned that behavioral responses can be altered to the point that verbal communications or actions seem uncharacteristic of the involved person. Dr. Moore, a clinical psychologist, supports the notion that the method in which one interprets stressors and manages their emotions under stressful circumstances is directly related to how the psychological stress affects the individual and their specific response. Survey question number four determined that 54% of all surveyed firefighters believe that they have responded inappropriately to an event as a result of their response to a stressful situation or environment. The research supports that individuals, while under stress, can have impaired cognition which can endanger themselves as well as others.

The fourth research question inquires about how firefighters can prepare their bodies to perform efficiently under stress. Dr. Augustine (J. J. Augustine, personal communication, August 7, 2007) maintains that a properly implemented physical fitness program can reduce the effects of physical stress to firefighters and can serve as a major factor in the reduction of injuries that firefighters are commonly involved in. Dr. Augustine mentions that dehydration influences the body's ability to regulate its core temperature with efficiency. He explains that a general understanding of physical fitness and proper hydration are beneficial to everyone. Another

suggestion that Dr. Augustine mentions deals directly with the rehab procedures. He believes that it is not only important to have enough firefighters on the scene to mitigate a situation, but it is necessary to have enough personnel on the scene to allow for proper rotation and rest without decreasing the group's work effectiveness and sacrificing the well-being of other firefighters at an emergency scene. The common issues of dehydration and over exertion are avoidable. He advises that muscle cramps are a classic sign of dehydration that follows prolonged physical exertion. The survey suggests that more than half of the participants surveyed have experienced muscle cramps during fire-ground operations. Thus, indicating a vulnerable spot in AFRD's rehabilitation program.

The fifth research question asked how firefighters can prepare for psychological stress during traumatic events. Dr. Moore (A. Moore, November 10, 2007), implies that it would be impractical to consider ignoring stressors. In fact, she suggests that one acknowledges his or her vulnerabilities to psychological stressors. Dr. Moore stated that although it is imperative that firefighters are trained to know the science of firefighting, it is also important to be exposed to the psychology of survival and methods of maintaining one's composure under extreme stress. She also suggests that one maintains an acute awareness of their emotional state and encourages participation in group debriefings or discussions. Finally, Dr. Moore advises that individuals with stressful lives or occupations should always take time to relax.

### Discussion/Implications

This study, for the greater part, concurs with most of the perspectives that were mentioned in the literature review. From the very beginning, I found that it was necessary to see how others have defined the term stress. Hawker (2002) defined stress as mental or emotional strain. This definition seemed extremely limited and really did not lend a lot to the direction of



the paper. In fact, I went in the other direction. Cline (1999) was on the same page as Hawker but he added the physical aspect of stress. Cline defined stress as bodily or mental tension. In my opinion, stress has to include more elements than being a condition of something. McEvoy (2002) contended that stress is a reaction to an event. This definition really opened my mind to the greater concept of stress and forced me to find additional information on the reality of reactions evolving from events that take place around us. Neddermeyer (2007) believes that stress is a perception. This makes sense because stress for one person may not be considered stress by another. Selye (1974) defined stress as a response to change. Although his definition is somewhat different than the others, it still encompasses the limited idea that stress is a result of a situation that the physical body is in. After considering all of the research and review of literature, I believe that a solid definition of stress has to include the concept that stress, whether physical or psychological, is an actuator that influences a response from the affected individual. Furthermore, the various forms of stress are interpreted differently by each individual. Therefore, each individual will respond according to his or her perception of the actuator.

When discussing the types of stress that firefighters are exposed to, I found that the relevant literature reviews provided a large amount of influence to the direction of this project. I am in total alignment with Brigati (1995) as he suggests that stress influences changes to one's cognitive and behavioral status. Wieder (1999) agrees with Brigati as he too supports the theory that a firefighter's physical and mental status can be affected on the fire-ground as a result to stress. Cline and Chapel (1999) divided psychological stress into four categories. Although I am familiar with many of the effects of stress, I had never considered that acute stress, cumulative stress, delayed stress and PTSD each have their own specific effect on the individual.

Historically, the fire service does not monitor or keep track of accumulating stress. This is truly an area that will need additional attention in the very near future.

When considering how stress affects the physiological processes of the body, the literature review and research offered perspectives from a variety of sources. Barnes (1999-2000) suggested that the most benign take-home artifact of firefighting is physical exhaustion. This makes sense because after a hard working shift with minimum sleep, firefighters need at least 24 hours to fully recover on sleep alone. Smith (2001) found that the pumping capacity of the heart is reduced during the highest time of demand. She notes that dehydration and heat stress, during firefighting duties, contribute to cardiovascular strain. This strain is directly related to the heart being impaired in its pumping capacity. This conclusion may be an enormous contributor to the large number of LODD that are attributed to cardiovascular failure. Peters, et al. (2007) offered an interesting association with lead exposure and psychological stress. Their research infers that when these two circumstances are combined, individuals have a marked increase for the occurrence of hypertension. This finding stimulates thought about the relationship of stress and the numerous other hazardous elements that firefighters come into contact with on a daily basis. The research that I conducted supports a portion of Brigati's (1995) claim that stress causes a physical response that promotes changes such as elevated blood pressure, increased oxygen consumption, muscle tension, glucose level changes, vassal and bronchial constriction. Personal MD (2007) makes an association with high stress and a marked increase chance of myocardial infarction. Stress was also linked to suppressed immune systems by Raebum (2006). This connection is very likely to be the cause of unwarranted spread of colds in the first responder community. The findings of Adam & Epel (2007) suggest that stress affects the hypothalamic-pituitary-adrenal and thus influences a nature of compulsive overeating. While Natural Life

Magazine (2007) suggests that weight gain is directly related to the perception and experience of stress by its study participants. I tend to agree with both of the views contributing to weight gain secondary to stress. Another finding by Vincent and Taylor (2007) suggest that chronic stress can increase the progression of insulin resistant syndrome resulting in cardiovascular disease. This link seems possible because of new information concerning the association of stress and diabetes. A classic age-old saying is that stress causes an individual to age rapidly. Pardon (2007) and his research adds a whole new twist as he suggests that stress can minimize or exacerbate the aging process. From personal experience, I have seen people who have aged dramatically in a short period of time while dealing with extremely stressful circumstances. The vital signs portion of my research project concurred with Torpy (2007) as he noted that stress increases pulse rate as well as causes blood vessels spasm and thus promoting the occurrence of arrhythmias, heart attacks and even death.

The research that I conducted, by way of survey, indicated that firefighters do experienced psychological impairment during stressful situations. The study that Peavy, et al. (2007) completed found that low-stressed subjects perform better than high stress subjects on memory tasks. Although the study involved mice, there could be a valid reference to people as well. I found it interesting that during the study, the stressed mice typically displayed cognitive impairment when placed under stressful circumstances that required memory recall. Another incredible finding suggests that the stress induced cognitive impairment was gender specific. Female mice performed with what was described as enhanced cognition under stress. Conversely speaking, male mice performed poorly under the same stress. I recall a television program, several years ago, that mentioned that a male subject's body would release massive quantities of testosterone into the body that directly influenced a chain of events that ultimately resulted in the

male performing poorly cognitively. In other words men made bad decisions under stress. While on the other hand, a female's body – responding to the same stress, would only release a moderate amount of testosterone which inevitably prevented her from over-compensating her cognitive response. On a similar note, Barnes (1999-2000) insists that emergency workers who experience chronic exposure to traumatic stressors will likely develop an emotional dysfunction. Reichel (1991) is in line with Barnes as he suggests that psychological stress pushes firefighters towards premature burnout. Unfortunately, it seems as though the concept of emotional callousness has been hugely overlooked by all of the researchers that I found. I tend to totally disagree with Mozingo and Plotkin (1997) as they believe that a repetition of moderate stress causes more psychological trauma than a single high stress experience. However, I agree with them as they note that only major events get the attention of debriefing sessions. In Atlanta, there is always a debriefing after the big event but never after 30 or 40 of the little events. Although employee assistance programs are available, personnel should have an awareness of other options that can be used to successfully cope with stress in an effort to ward off the effects of physical and psychological stress.

Additionally, the research that was conducted to benefit this applied research project provided a wealth of usable data. The vital signs study supported that the bodies of healthy firefighters will experience drastic changes in pulse rate an increase in oxygen demand with the perception of high stress. On the other hand, it is difficult to say whether or not the stress was from perception or a reaction from being startled, as they were suddenly awakened from a deep sleep. Regardless, the heart going from 0 to 100 mph every third day and occurring five to twenty times a day has to take a toll on all the systems of the body. After reviewing the data from the survey, I question the validity of some of the responses. I believe that many of the

firefighters did not answer yes to a few of the questions because a yes answer would make them seem out of shape or appear as a physical or mentally at-risk firefighter. A good example is survey question number four which involves decision or actions under stress. I personally know several firefighters who have snatched their masks off in hostile environments because something went wrong and stressed them beyond clear cognition.

As I considered the methods in which firefighters may be able to prepare their bodies to perform under stress, I determined that I concur with Smith (2001) and Dr. Augustine (J. J. Augustine, personal communication, August 7, 2007) as they both promote physical fitness, staffing levels and hydration as the keys being physically prepared. Parker (2001) speaks of issues concerning the environment and its effect on the body. He believes that working in humid environments with exposures of heat stress makes the firefighters an easy target for the complications dehydration. I agree with the suggestion of the implementation of a proper and effective rehabilitation program to combat the effects of working in extreme environments.

During my reviews of literature, I noticed that there were a few authors who believed that one of the best methods of preparing for psychological stress is by dealing with it appropriately. A popular method that I have never considered involves writing things down and getting them out of one's mind. Neddermeyer (2007) suggests creating a list of things that are perceived as stressors. I agree with her idea that the list should be prioritized and that one should make plans to eliminate long-term stress by referring to the list. Seaward (2000) and Fishkin (1991) both agree with Neddermeyer as they support some form of listing or journaling to deal with stress and maintain one's psychological balance. Rivard (2007) and his theory agreed with Neddermeyer's theory in respect that stress is at the mercy of one's perception. Although I tend to accept all of their theories, I believe that perception only accounts for psychological stress and

does not entertain the concept of physiological stress. In the article *How to Relax After Work* (2007), the author advises that one should designate a specific period of time after work to relax and unwind without interruptions. This method may assist firefighters who were not able to leave their stress at work. Lastly, Rhéaume (2007) offers the suggestion botanicals as a method of returning normalcy to hectic days filled with stress. These botanicals are means of helping the cope with stress. I am against the use of botanicals because it seems as though the stress is simply being suppressed rather than being eliminated.

In summary of this discussion, I believe that the argument of stress serving as a primary culprit of firefighter serious injuries and death is overwhelmingly strong. Whether the adverse reaction is from physiological or psychological stress, it is clear that both forms of stress can be deadly. It now seems basically obvious that the author and others of interest get the message across to our firefighters and notify them of the harsh reality of the effects of stress. It is of my opinion that this was the exact culprit that resulted in one of AFRD's firefighter LODDs. The other suffered a massive heart attack in the station.

### Recommendations

Atlanta Fire's problem of not being able to link the effects of stress on firefighters leaves the department vulnerable to additional firefighters being seriously injured or killed. It is believed that Atlanta Firefighter Steven Solomon, while under the most extreme stress and hostile environment, removed his face piece and stood up to attempt to exit the burning structure. In the perfect world, a firefighter will keep his/her calm and conduct themselves as they were trained. The occupation of firefighting and this world is far from perfect. Therefore, the incorporation of an understanding of the psycho-physiology of stress should complement the rigorous training that is already in place. A general understanding of this concept should lead to

fewer fire ground injuries and illnesses such as premature fatigue, muscle cramps and heat related illnesses. Newer and more informative policies must be developed and introduced into the culture in a non threatening manner for a broader buy-in by the members. Presently, Atlanta Fire supports physical fitness and pays for a department wide physical every other year. This wellness program can be augmented in several ways to incorporate prevention awareness to the masses. Most firefighters have no idea of how dehydration contributes to heat exhaustion, heat stroke or muscle cramps. Similar to overcoming an addiction, one must first acknowledge that there is a problem and take aggressive actions to correct it or stop it from happening again. Understanding stress and its effects will not be an easy task to drop in the laps of the firefighting community. But it is a subject that must not be hidden anymore. Now is the time to save some lives.

As a student of the National Fire Academy's Executive Fire Officer Program, it is now my responsibility to share this researched subject with other members of Atlanta Fire and seek additional buy-in with keys players throughout the department. I plan to create a power point presentation, with the help and input of others, for the introduction to the department's executive staff. If allowed, I plan to work closely with the AFRD training staff as well as the city of Atlanta's Psychological Services community. I will seek input from firefighters on methods that will enable the city's mental and healthcare professionals to continuously monitor and assess stress and its effects on the mind and body. A monumental task involves the strategic development and implementing of a class for the 100+ fire-recruits that AFRD hires each year.

## Appendix A



## The Physiological & Psychological Effects of Stress on Firefighters Survey



Atlanta Fire Rescue Department



1.) Have you ever experienced a constricting feeling around your chest, chest pains or an increase in difficulty breathing during or after firefighting duties?      Yes ☐      No ☐

2.) Have you ever felt nauseous or dizzy during or after firefighting duties?      Yes ☐      No ☐

3.) Have you ever experienced muscle cramps during firefighting operations?      Yes ☐      No ☐

4.) In retrospect, have you ever made a decision or did something totally against your good sense and training, as a result of your response to a stressful situation or environment?      Yes ☐      No ☐

5.) In general, have you ever felt your body's physiological response to stress prior to conducting firefighting operations (example: en route to a confirmed working-fire with entrapment)?      Yes ☐      No ☐

6.) While at the fire station, have you ever received an alarm that woke you up from a deep sleep and you were able to notice palpitations of your heart as it increased in beats per minute?      Yes ☐      No ☐

7.) Are you aware of the effects of physiological & psychological stress to a firefighter's mind and body?      Yes ☐      No ☐



## Appendix B



## The Physiological & Psychological Effects of Stress on Firefighters Results



Atlanta Fire Rescue Department



1.) Have you ever experienced a constricting feeling around your chest, chest pains or an increase in difficulty breathing during or after firefighting duties?	38% Yes	62% No
2.) Have you ever felt nauseous or dizzy during or after firefighting duties?	44% Yes	56% No
3.) Have you ever experienced muscle cramps during firefighting operations?	51% Yes	49% No
4.) In retrospect, have you ever made a decision or did something totally against your good sense and training, as a result of your response to a stressful situation or environment?	54% Yes	46% No
5.) In general, have you ever felt your body's physiological response to stress prior to conducting firefighting operations (example: en route to a confirmed working-fire with entrapment)?	67% Yes	33% No
6.) While at the fire station, have you ever received an alarm that woke you up from a deep sleep and you were able to notice palpitations of your heart as it increased in beats per minute?	62% Yes	36% No
7.) Are you aware of the effects of physiological & psychological stress to a firefighter's mind and body?	87% Yes	13% No

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